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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* FRANCOIS BLAUDIN DE THE

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Appeal 2010-001308  
Application 10/583,626  
Technology Center 3600

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*Before* WILLIAM F. PATE, III, DANIEL S. SONG, and  
EDWARD A. BROWN, *Administrative Patent Judges*.

BROWN, *Administrative Patent Judge*.

DECISION ON APPEAL

The Appellant appeals under 35 U.S.C. § 134(a) from a Final Rejection of claims 6-13 (App. Br. 2). Claims 1-5 were cancelled (App. Br. 2). We have jurisdiction over this appeal under 35 U.S.C. § 6(b). We AFFIRM-IN-PART.

The invention is directed to a fuel rod for a water-cooled nuclear reactor (Spec. p. 1, ll. 2-4)<sup>1</sup>. Independent claim 6 is representative of the appealed claims and reads as follows (App. Br. 17, Claims Appx., emphasis added):

6. A fuel rod for a nuclear reactor that is cooled by water, comprising:
  - a cylindrical tubular cladding;
  - a column of nuclear fuel pellets that are stacked one on top of another inside the tubular cladding in the axial direction of the cladding;
  - a first plug for tight closure of a first axial end of the cladding of the rod arranged at a lower portion of the fuel rod when the rod is in an operating position inside the nuclear reactor, the cladding of the rod having an axis vertical; and
  - a second plug for tight closure of the second axial end of the cladding, the column of fuel pellets resting on an inner portion of the first plug, referred to as a lower plug, via a first lower end, and being retained inside the tubular cladding by a compression spring that is interposed between a second upper axial end of the column of fuel pellets and an end of an inner portion of the second plug, referred to as the upper plug, wherein the inner portion of the lower plug engaged inside the tubular cladding successively comprises, in the axial direction and in a direction from the first towards the second end of the cladding, a first cylindrical portion that

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<sup>1</sup> All references herein to the Specification are to the Substitute Specification filed on June 20, 2006.

has a diameter that is substantially equal to the inner diameter of the tubular cladding, a second cylindrical portion that has a diameter that is smaller than the inner diameter of the tubular cladding and a third cylindrical portion that has a diameter that is smaller than the inner diameter of the tubular cladding and that is greater than the diameter of the second cylindrical portion so that there remains, between a lateral outer surface of the third cylindrical portion and an inner surface of the tubular cladding, a radial clearance for passage of gas and a substantially planar end surface on which the first end of the column of fuel pellets rests, so that *an annular space for expansion of gas is formed between the outer surface of the second portion of the inner portion of the lower plug and the inner surface of the cladding, a volume of the annular space being a function of expansion of gas in the fuel rod during operation.*

## THE REJECTIONS

The following Examiner's rejections are before us for review:

1. Claim 12 is rejected under 35 U.S.C. § 112, second paragraph, as omitting essential steps.

2. The following claims are rejected under 35 U.S.C. § 103(a) as being unpatentable over the noted references:<sup>2</sup>

A. Claims 6, 12 and 13 over Bresnick (US 3,804,710, issued Apr. 16, 1974) in view of Appellant's Admission.

B. Claims 7 and 8 over Bresnick in view of Clapham (US 4,046,631, issued Sept. 6, 1997).

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<sup>2</sup> As claims 7-10 depend from claim 6, we understand rejections "B," "C" and "D" below to be over Appellant's Admission in addition to the noted references.

C. Claim 9 over Bresnick in view of Ocken (US 4,120,752, issued Oct. 17, 1978).

D. Claim 10 over Bresnick in view of Hayashi (US 4,111,748, issued Sept. 5, 1978).

E. Claim 11 over Bresnick in view of Ocken.

## ISSUES

The following issues have been raised in the present appeal.

1. Whether the Examiner erred in finding that the method of manufacturing a fuel rod recited in claim 12 fails to recite "essential steps."

2. Whether the Examiner erred in concluding that the combination of Bresnick and Appellant's Admission renders obvious the fuel rod recited in claim 6 with "a volume of the annular space being a function of expansion of gas in the fuel rod during operation."

3. Whether the Examiner erred in concluding that the combination of Bresnick, Appellant's Admission, and Clapham renders obvious a fuel rod having the size of the radial clearance recited in claim 7.

4. Whether the Examiner erred in concluding that the combination of Bresnick, Appellant's Admission, and Clapham renders obvious a fuel rod having the numerical limitations in claim 8 for the respective diameter and length of the second cylindrical portion relative to the inner diameter of the tubular cladding.

5. Whether the Examiner erred in concluding that the combination of Bresnick, Appellant's Admission, and Ocken renders obvious the fuel rod

recited in claim 9 which comprises fuel pellets that comprise one of plutonium oxide and a mixed oxide of uranium and plutonium.

6. Whether the Examiner erred in concluding that the combination of Bresnick, Appellant's Admission, and Hayashi renders obvious the fuel rod recited in claim 10 which comprises at least one cross-member as recited.

## ANALYSIS

### *Rejection of claim 12 under 35 U.S.C. § 112, second paragraph*

Claim 12 recites "[a] method for manufacturing the fuel rod as recited in claim 6 comprising: determining the volume of the second intermediate portion as a function of the expansion of gases in the fuel rod during operation" (App. Br. 19, Claims Appx.). The Appellant argues contrary to the Examiner that claim 12 recites manufacturing the full and complete fuel rod of claim 6, and does not omit essential elements (App. Br. 6-7; Ans. 3, 13.)

We agree with the Appellant. Claim 12 makes reference to the fuel rod as recited in claim 6 and, accordingly, includes all of the limitations of claim 6 for the fuel rod. These limitations for the fuel rod are given weight in the method recited in claim 12. The test for definiteness of claim language under 35 U.S.C. § 112, second paragraph, is whether "those skilled in the art would understand what is claimed when the claim is read in light of the specification." *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1576 (Fed. Cir. 1986) (citations omitted). We find the language of claim 12 to be clear in light of the specification, and hence in compliance

with 35 U.S.C. § 112, second paragraph. Thus, we do not sustain the Examiner's rejection of claim 12.

*Rejection of claims 6, 12 and 13 as obvious over Bresnick in view of Appellant's Admission*

As to independent claim 6, the Examiner finds that Bresnick discloses a fuel rod for a nuclear reactor comprising, *inter alia*, a "lower plug" 6 (i.e., bottom end plug) including a "first cylindrical portion" 13 (i.e., inner tapered section), a "second cylindrical portion" 16 (i.e., neck portion), and a "third cylindrical portion" 14 (i.e., head portion); a radial clearance for passage of gas between a lateral outer surface of the head portion 14 and an inner surface of the tubular cladding 1; and an annular space for expansion of gas between the outer surface of the neck portion 16 and the inner surface of the cladding 1 (Ans. 5; *see* Bresnick col. 2, ll. 11-12, ll. 16-31 & ll. 39-50; FIGS. 1, 2). The Examiner finds that Bresnick does not disclose the limitation that "a volume of the annular space being a function of expansion of gas in the fuel rod during operation" (Ans. 5), but finds that "Appellant admits that a conventional method of increasing the volume for expansion of the gases in the fuel rod is to provide an upper and lower plenum in the fuel rod (which is what Bresnick does (figure 1))" (Ans. 5; *see* Spec. p. 3, ll. 7-17). The Examiner concludes that providing a fuel rod having the recited volume limitation would have been obvious (Ans. 5).

The Appellant contends that Bresnick does not disclose or suggest the expansion of gases within the fuel rod (App. Br. 9). The Appellant also contends that the admission in the Specification is merely that it is

conventional to put a shim on the bottom end plug in a fuel rod to increase free space for expansion of gases during operation, and modifying the space below the head portion 14 of Bresnick would be solely based on hindsight (App. Br. 9).

The Appellant's arguments are not persuasive. Firstly, the Appellant does not contest the Examiner's finding that Bresnick's fuel rod includes a radial clearance between the lateral outer surface of the head portion 14 and the inner surface of the tubular cladding 1 for passage of gas (Ans. 5; see FIG. 1). We find that this radial clearance would allow gas passage from the lower-most fuel pellet 2 into the annular space between the outer surface of the neck portion 16 and the inner surface of the cladding 1. Although Bresnick does not describe that gas expansion occurs in the annular space, the presence of the annular space increases the volume in the fuel rod in which such gas expansion occurs (i.e., in addition to fission gas receiving chamber 3).

We determine that the recitation of "a volume of the annular space being a function of expansion of gas in the fuel rod during operation" does not specify any particular functional relationship between the volume of the annular space and the expansion of gas in the fuel rod, or specify any particular structure for the lower plug. We find no error in the Examiner's finding that Bresnick's inner tapered section 13, neck portion 16, and head portion 14 can be considered to function as a "shim" in the fuel rod, in that this structure likewise defines an additional volume for gas expansion between the collar 11 and lower-most pellet 2 (Ans. 14). We agree with the Examiner that it would have been obvious to construct the annular space in

Bresnick's fuel rod "to have a volume that is a function of the expansion gas in the fuel rod" as claimed, in light of Appellant's admission that it is conventional for fuel rods to have a lower plenum to provide increased volume therein for gas expansion. Thus, we sustain the obviousness rejection of claim 6.

Claim 12, discussed *supra*, and claim 13 depend from claim 6. The Appellant relies on the same arguments made with respect to patentability of claim 6 for patentability of claims 12 and 13 (App. Br. 9). Because we find no deficiencies in the Examiner's rejection of claim 6, we also sustain the obviousness rejection of claims 12 and 13.

*Rejection of claims 7 and 8 as obvious over Bresnick in view of Appellant's Admission and Clapham*

As to claim 7, the Examiner finds that Bresnick fails to teach that the radial clearance between the outer lateral surface of the head portion 14 and the inner surface of the cladding 1 is between one and two tenths of a millimeter. The Examiner relies on Clapham for teaching a radial clearance between a "third cylindrical portion" 7 (i.e., flange) and a "tubular cladding" 1 (i.e., tube). The Examiner concludes that although neither Bresnick nor Clapham discloses the specific value recited in claim 7, it would have been obvious for one skilled in the art to find that the claimed value is an appropriate/sufficient radial clearance in Bresnick (Ans. 7-8). Contrary to the Examiner, the Appellant contends that one skilled in the art would not have optimized the radial clearance in Bresnick to have the claimed value

because there is no recognition that the clearance size is a result-effective variable (App. Br. 15).

We find no error in the Examiner's conclusion of obviousness. Firstly, as noted *supra*, the Appellant does not dispute the Examiner's finding that Bresnick's fuel rod includes a radial clearance for gas passage between the lateral outer surface of the head portion 14 and the inner surface of the cladding 1. Clapham discloses that gas can traverse the gap 7a between the flange 7 and tube 1 (col. 3, ll. 18-21). The Appellant does not explain why one skilled in the art would not have recognized the size of the radial clearance in Bresnick to be a result-effective variable (i.e., a variable that achieves a recognized result). Moreover, Appellant's Specification describes merely that a radial clearance size as claimed allows gas to pass from the column of fuel pellets 3 at the periphery of the third portion 13 (Spec. p. 10, ll. 8-15). The Appellant does not direct us to any evidence that shows the claimed radial clearance size is critical, or provides any unexpected result. Hence, we agree with the Examiner that one skilled in the art would be able to determine through routine experimentation an optimum or workable radial clearance size in Bresnick. Thus, we sustain the Examiner's obviousness rejection of claim 7.

As to claim 8, the Examiner finds that Bresnick fails to teach that the neck portion 16 has a diameter of between 40% and 60% of the inner diameter of the cladding, and a length in the axial direction of between 8 and 10 times the inner diameter of the cladding (Ans. 8). The Examiner relies on Clapham for teaching that the "second cylindrical portion" 6 (i.e., stem) has a diameter of about 18% of the inner diameter of the tube 1 (Ans. 8). The

Examiner concludes that although neither Bresnick nor Clapham discloses the specific values recited in claim 8, it would have been obvious to optimize the diameter and length of the neck portion 16 relative to the inner diameter of the cladding 1 in Bresnick to have the claimed values (Ans. 8). The Appellant contends that one skilled in the art would not have optimized these variables to have the claimed values because there is no recognition that they are result-effective variables (App. Br. 11).

We agree with the Appellant that the Examiner has not shown that it would have been obvious for one skilled in the art to optimize both the diameter and the length of the neck portion relative to the inner diameter of the cladding in Bresnick to have the claimed values. In this regard, Bresnick describes that the head portion 14 of the plug 6 is spaced from the inner tapered section 13 to keep the fuel pellets 2 a sufficient distance from the weld 20 formed between the tube 1 and the periphery of the shoulder 12, so as to prevent temperature gradients or fuel pellet swelling from producing unacceptable high stresses that could rupture the weld or cladding near the weld (col. 3, ll. 3-6 & 14-23; FIGS. 1 & 2). Bresnick describes that the head portion 14 is spaced from the inner tapered section 13 by a predetermined distance and supported by the neck portion 16 of reduced diameter (col. 2, ll. 49-51; FIGS. 1, 2). Hence, in Bresnick, the predetermined distance is selected based on heat transfer considerations.

Claim 8 requires that the second cylindrical portion have a diameter of between 40% and 60% of the inner diameter of the tubular cladding, *and* also a length in the axial direction of between 8 and 10 times the inner diameter of the tubular cladding. While optimizing both the diameter and

the length of the neck portion 16 relative to the inner diameter of the cladding 1 in Bresnick, in accordance with Bresnick's teachings, might result in the fuel rod defined in claim 8, the Examiner has not shown that this result would necessarily occur. Rather, the Examiner's position is based on speculation as to what particular values these particular dimensions would have upon being optimized to keep the fuel pellets 2 a safe distance from the weld 20 to reduce the temperature gradient to an acceptable level. The Examiner's application of Clapham does not provide an alternate rationale for dimensioning these components to have, or result in, the recited proportions. Hence, we do not sustain the obviousness rejection of claim 8.

*Rejection of claim 9 as obvious over Bresnick in view of Appellant's Admission and Ocken*

Claim 9 recites that "at least a portion of the fuel pellets ... comprises one of plutonium oxide and a mixed oxide of uranium and plutonium" (App. Br. 18, Claims Appx.). The Examiner finds that Bresnick fails to teach that the fuel pellets 2 meet this limitation. The Examiner relies on Ocken for disclosure of mixed oxide fuel pellets of uranium and plutonium, and concludes that it would have been obvious to use these mixed oxide fuel pellets as the fuel source in Bresnick to provide the necessary heat energy (Ans. 9). The Appellant contends that one skilled in the art would know that Bresnick's fuel rod is not suitable for use with MOX fuel because it is not designed to have expansion space or gas capabilities for use with MOX pellets (App. Br. 12-13).

We find the Appellant's arguments unpersuasive. Firstly, we find the Examiner has articulated a rational reason for combining Bresnick, Appellant's Admission, and Ocken together; that is, to provide the necessary heat energy in Bresnick's fuel rod. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). On the other hand, the Appellant has not set forth persuasive evidence establishing that Bresnick's fuel rod would be unsuitable for use with the claimed fuel pellets. In this regard, claim 9 does not recite any structural limitations for the lower plug that are not found in Bresnick's plug 6. Moreover, the Appellant admits that it is conventional to use shims in MOX fuel rods to increase gas expansion space (see Spec. p. 3, ll. 7-17), and we find no error in the Examiner's finding that Bresnick's fuel rod also includes structure that functions as a "shim." Claim 9 requires only that a portion of the fuel pellets have the recited composition. The Appellant has not shown evidence that Bresnick's fuel rod would be unsuitable for use if it contained any amount of the claimed fuel pellets. Hence, we sustain the obviousness rejection of claim 9.

*Rejection of claim 10 as obvious over Bresnick in view of Appellant's Admission and Hayashi*

The Examiner finds that Bresnick fails to disclose at least one cross-member as claimed in at least one zone of the "second cylindrical portion." The Examiner relies on Hayashi for disclosure of an end plug 5 / supporting structure 3e combination that has a "cross-member" 6e (i.e., cylindrical body) in the zone of the "second cylindrical portion" 13 (i.e., grooves) (Ans. 10; Hayashi col. 4, ll. 16-19; FIGS. 1, 7b). The Examiner concludes that it

would have been obvious to design the end plug of Bresnick "to allow the production of a series of successive breaks to thereby allow retention of relatively uniform distribution of stress in the cladding tube or at the plugged end junctures" (Ans. 10).

The Appellant contends that Hayashi does not disclose or teach the claimed cross-member (App. Br. 13-14). However, the Appellant's conclusory assertion does not explain how the claim language distinguishes over Hayashi's cylindrical body 6e, and thus does not identify a basis for concluding that the Examiner's findings are erroneous. Hence, we sustain the obviousness rejection of claim 10.

*Rejection of claim 11 as obvious over Bresnick in view of Ocken*

Independent claim 11 is similar to claim 6, with claim 11 reciting that "at least a portion of the fuel pellets of the column of fuel pellets comprises one of plutonium oxide and a mixed oxide of uranium and plutonium" (App. Br. 18, Claims Appx.). The Examiner's rationale is substantially the same as for the rejection of claim 9, discussed *supra* (Ans. 11-12). The Appellant relies on the same arguments made with respect to patentability of claim 9 for patentability of claim 11 (App. Br. 15). Because we find no deficiencies in the Examiner's rejection of claim 9, we also sustain the obviousness rejection of claims 11.

## CONCLUSIONS

1. The Examiner erred in finding that the method of manufacturing a fuel rod recited in claim 12 fails to recite "essential steps."

2. The Examiner did not err in concluding that the combination of Bresnick and Appellant's Admission renders obvious the fuel rod recited in claim 6 with "a volume of the annular space being a function of expansion gas in the fuel rod during operation."

3. The Examiner did not err in concluding that the combination of Bresnick, Appellant's Admission, and Clapham renders obvious a fuel rod having the size of the radial clearance recited in claim 7.

4. The Examiner erred in concluding that the combination of Bresnick, Appellant's Admission, and Clapham renders obvious a fuel rod having the numerical limitations in claim 8 for the respective diameter and length of the second cylindrical portion relative to the inner diameter of the tubular cladding.

5. The Examiner did not err in concluding that the combination of Bresnick, Appellant's Admission, and Ocken renders obvious the fuel rod recited in claim 9 which comprises fuel pellets that comprise one of plutonium oxide and a mixed oxide of uranium and plutonium.

6. The Examiner did not err in concluding that the combination of Bresnick, Appellant's Admission, and Hayashi renders obvious the fuel rod recited in claim 10 which comprises at least one cross-member as recited.

## DECISION

1. The Examiner's rejection of claim 12 under 35 U.S.C. § 112, second paragraph, is REVERSED.

2. The Examiner's rejection of claims 6, 12 and 13 as unpatentable over Bresnick in view of Appellant's Admission is AFFIRMED.

3. A. The Examiner's rejection of claim 7 as unpatentable over the combination of Bresnick, Appellant's Admission, and Clapham is **AFFIRMED**.

B. The Examiner's rejection of claim 8 as unpatentable over the combination of Bresnick, Appellant's Admission, and Clapham is **REVERSED**.

4. The Examiner's rejection of claim 9 as unpatentable over the combination of Bresnick, Appellant's Admission, and Ocken is **AFFIRMED**.

5. The Examiner's rejection of claim 10 as unpatentable over the combination of Bresnick, Appellant's Admission, and Hayashi is **AFFIRMED**.

6. The Examiner's rejection of claim 11 as unpatentable over Bresnick in view of Ocken is **AFFIRMED**.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED-IN-PART

JRG